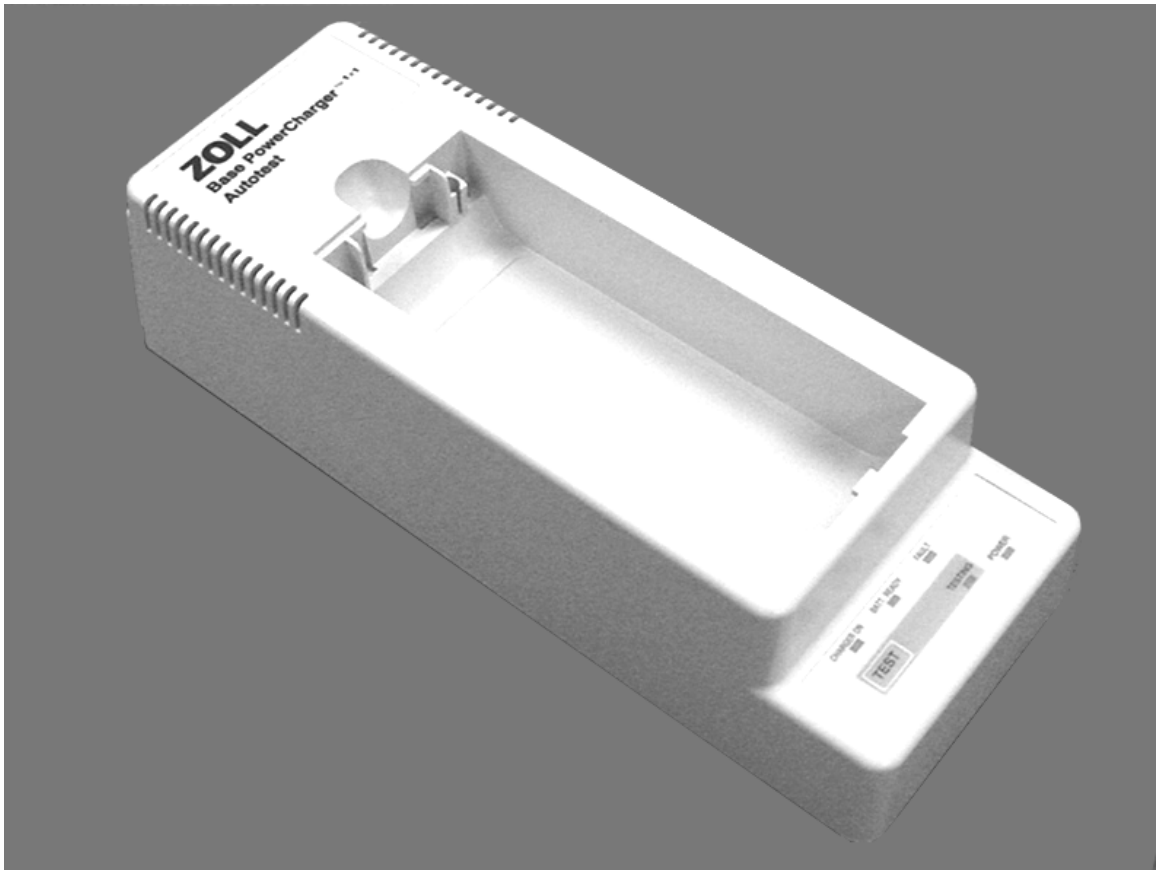
ZOLL Base PowerCharger 1x1 Service Manual



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SECTION I
GENERAL INFORMATION

TABLE OF CONTENTS

DESCRIPTION **SECTION**

I. General Information

- Table of Contents I-1
- Safety Considerations I-2
- How to Use This Manual I-4
- Symbols used on the Equipment I-6
- Service I-7

II. Checkout Procedures

- Leakage Current Test II-2
- Functional Tests II-2
- Manual Test II-3
- Checkout Procedure Data Sheet II-4

III. Troubleshooting Guides

- Troubleshooting Table III-2
- Fault Codes Table III-3
- Definition of Fault Codes III-4

IV. Functional Descriptions

- System IV-2
- Charger Circuit Description IV-3
- Battery Compartment Circuit Description IV-5

V. Disassembly Procedures

- Removing the Upper Housing Cover V-2
- Removing the PCB Assembly V-4
- Removing the Transformer V-6
- Removing the Power Entry Module V-8

VIII. Replacement Parts

- Field Replaceable Unit VI-2

SAFETY CONSIDERATIONS

WARNINGS

General

- The following is a list of service related safety considerations. For operation related safety considerations see the Base PowerCharger^{1x1} Operator's Guide. Service Technicians should be aware of all safety considerations prior to servicing the equipment.
- **THE BASE POWERCHARGER^{1x1} DEVICE SHOULD BE SERVICED BY QUALIFIED PERSONNEL ONLY!** Unauthorized persons should not attempt to service this device.

  The ZOLL Base PowerCharger^{1x1} is protected against interference from radio frequency emissions typical of two-way radios used in emergency service/public safety activities. Users of the ZOLL Base PowerCharger ^{1x1} should assess the devices' performance in their environment of use for the possibility of radio frequency interference from high-power sources.
- Use only the AC power line cord supplied with the device. Failure to use the proper line cord could result in excess leakage currents and reduced safety.
- Only Qualified Personnel should disassemble the PowerCharger^{1x1}. A shock hazard exists. Refer all problems to ZOLL Technical Service.
- Follow all recommended maintenance instructions. If a problem occurs, obtain service immediately. Do not use the Base PowerCharger ^{1x1}until the unit has been inspected by the appropriate personnel.
- Do not place anything on top of or beneath the ZOLL Base PowerCharger^{1x1}, such as blankets or cloths. Doing so may block the vents on the unit, preventing proper dissipation of heat during operation.
- Do not sterilize the Base PowerCharger^{1x1}.
- Do not use alcohol or ketones (MEK, acetone, etc.) on the Base PowerCharger^{1x1}.
- Always wait until the Base PowerCharger^{1x1}has completed its charge cycle before removing batteries.
- Repeated use of partially charged batteries will reduce their capacity and operating life.
- Do not use a battery unless the **BATT. READY** indicator is lit and the **FAULT** light is off. Failure to do so may result in the use of a fully depleted battery.
- Only charge XL Battery packs in a ZOLL Base PowerCharger 1x1 marked "XL Battery Ready". Failure to do so will reduce battery capacity and operating life.
- Do not install batteries into Monitor/Defibrillators when storage may exceed 90 days. Battery damage may occur.

WARNINGS

Operator Safety

- Do not operate the ZOLL Base PowerCharger 1x1 in the presence of flammable agents (such as gasoline), oxygen-rich atmospheres, or flammable anesthetics. Using the device near the site of a gasoline spill may cause an explosion.
- Do not immerse or set the Base PowerCharger 1x1 in fluid. Using the device near or within puddles of water may present a shock hazard to the operator, patient, or nearby personnel.

Patient Safety

- Do not mount the device directly above the patient. Locate the Base PowerCharger 1x1 and ZOLL resuscitation devices where they cannot harm the patient if they fall.

Caution

- Do not discharge any ZOLL battery pack except in a Base PowerCharger 1x1 or compatible ZOLL Battery Charging/Testing device.
- Safety and effectiveness data submitted to the Food and Drug Administration (FDA) under section 510(K) of the Medical Device Act by ZOLL Medical Corporation to obtain approval to market is based upon the use of ZOLL accessories such as disposable electrodes, patient cables and batteries. ZOLL cannot make representations as to safety and clinical effectiveness when a device is used with non-ZOLL accessories. Users assume all responsibility for the safety and effectiveness of ZOLL products if used with non-ZOLL accessories. Further, ZOLL disclaims all implied and expressed warranties, including warranties of fitness and merchantability, and all product liability to the extent possible in the event of the use of a non-ZOLL accessory.
- The equipment may only be used with disposables, accessories, and consumable items when an agency, accredited for the testing of the equipment, has established that those items, in their intended use, meet its safety requirements.
- Federal (U.S.A.) law restricts this device to sale by or on the order of a physician.
- When you place a fully charged battery into the ZOLL Base PowerCharger 1x1 with AutoTest, the AutoTest will **NOT** activate and the **BATT. READY** indicator will illuminate within a few minutes after inserting the battery into the charger. Therefore, it is possible to have a shorter battery run time than expected from the AutoTest.

HOW TO USE THIS MANUAL

Who it is for

The Base PowerCharger ^{1x1} Service Manual is a basic technical reference document designed for biomedical engineering personnel whose responsibilities include maintenance and repair of medical equipment.

Purpose

Its purpose is to provide the basic information needed to allow biomedical engineering personnel to identify and/or repair the Base PowerCharger ^{1x1} to the sub-assembly (printed circuit board) level.

Recommended Use

The Service Manual should be readily available in the facility's equipment maintenance library. It will be used for preventive maintenance checks and for troubleshooting when problems are reported.

The Operator's Guide will be used in training new operators and for operational reference. This copy should be kept with the Base PowerCharger^{1x1} Service Manual. A separately bound copy should be kept with the Base PowerCharger^{1x1} device.

This service manual consists of several key sections:

Section I: General Information

This section contains a number of important notices and reference material, including safety warnings and ZOLL's warranty statement. **Be sure to review this section thoroughly before attempting to use or service the Base PowerCharger ^{1x1} device.**

Section II: Checkout Procedures

This section contains information you need in order to verify that the Base PowerCharger^{1x1} is functioning properly, and procedures for checking the Base PowerCharger^{1x1}.

For daily inspection and operational checks, see the Operator's Manual.

Section III: Troubleshooting Guides

This section contains an operational troubleshooting section, for use by non-technical personnel to respond to common problems detected during Base PowerCharger^{1x1} operational use.

Section IV: Functional Descriptions

This section provides a basic technical description of the Base PowerCharger^{1x1} main subassembly modules. The information should be thoroughly reviewed before attempting to service the product.

Section V: Disassembly Procedures

Step-by-step instructions are provided for removing subassemblies in the event of failure. Refer to the Service Policy in Section I for return and repair information.

Section VI: Replacement Parts

This section contains a detailed listing of ZOLL part numbers for field replaceable parts available for the Base PowerCharger 1x1 and will allow the service person to identify and order replacement parts. No attempt to replace parts at the component level should be attempted or the ZOLL warranty may be voided.

Symbols Used on the Equipment

Any or all of the following symbols may be used in this manual or on this equipment :

Type B patient connection

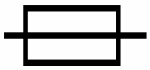
Type BF patient connection

Type CF patient connection

Defibrillation protected Type BF patient connection

Defibrillation protected Type CF patient connection

ATTENTION Refer to manual for more information


Fusible link

Protective (earth) ground terminal

Equipotentiality

DANGER High voltage present

Alternating current

DANGER Risk of explosion if used in the presence of flammable anesthetics

Conformité Européenne Complies with the Medical Device Directive 93/42/EEC

Service

The Base PowerCharger^{1x1} does not require periodic recalibration or adjustment. Appropriately trained and qualified personnel should, however, perform periodic tests of the device to ensure proper operation. See the **QuickCharge** and **AutoTest** sections of the *Base PowerCharger ^{1x1} Operator's Manual* for more information.

U.S.A. Customers

Should the ZOLL Base PowerCharger^{1x1} require service, contact ZOLL Medical Corporation at 1-800-348-9011 (in Massachusetts: 1-781-229-0020).

Please have the following information available to expedite service:

The unit's serial number

A description of the problem

Department where equipment is being used

A purchase order to allow tracking of loan equipment

You will be given a Return Claim Number under which to return the ZOLL Base PowerCharger^{1x1}. Send the unit in its original packaging or equivalent to:

ZOLL Medical Corporation
32 Second Avenue
Burlington, MA 01803-4420

Attn: Technical Service Department

Loaner instruments are available for use while repairs are being completed by ZOLL's Technical Service Department.

International Customers

Should the Base PowerCharger^{1x1} require service, return the unit in its original packaging or equivalent to the nearest authorized ZOLL Medical Corporation service center. To determine which authorized ZOLL Medical Corporation service center to use, write, call or fax:

ZOLL Medical Corporation
32 Second Avenue,
Burlington, Massachusetts 01803-4420, USA
Attn: International Sales Department

1-781-229-0020 (voice)

or

1-781-272-5443 (fax)
Attn: International Sales Department

SECTION II
CHECKOUT PROCEDURES

ZOLL recommends that you check your Base PowerCharger^{1x1} for proper operation at least once every six months.

This section contains information you need in order to verify that the Base PowerCharger^{1x1} is functioning properly.

Daily operational checks are described in Section 3, **Maintenance and Troubleshooting,** of the *Base PowerCharger ^{1x1} Operator's Guide*.

TABLE OF CONTENTS

1. Leakage Current Test II-2

2. Functional Test II-2

3. Manual Test II-3

4. Checkout Procedure Data Sheet II-4

LEAKAGE CURRENT

- Perform Leakage Current Test per the recommended procedure found in the Operator's Manual of your Leakage Tester.

Observe:

- After the test is complete, fill in the date , operator, and Base PowerCharger^{1x1} serial number on the Test Data Sheet (Page II-4). Review the results against the limits below for any test that failed. If any test fails, circle the failed test on the Test Data Sheet and take corrective action.
- Record results on Test Data Sheet (Page II-4).

TEST	90 - 265 VAC LIMITS
Chassis Leakage	
Normal Pol. w/Ground	< 100 μA
Normal Pol. No/Ground	< 500 μA
Reverse Pol. No/Ground	< 500 μA
Reverse Pol. w/Ground	< 100 μA
Ground Wire Leakage	
Normal Pol. No/Ground	< 500 μA
Reverse Pol. No/Ground	< 500 μA

FUNCTIONAL TESTS

Continuity and Isolation Test

- Take a measurement of the Digital Volt Meter (in ohms) by shorting the two (2) leads of the DVM.
- Record Results on Test Data Sheet (Page II-4).
- Place the red lead of the DVM on any part of the unit where there is exposed metal, except for the battery terminals, and place the black lead of the DVM on the ground terminal of the power cord.
- Record Results on Test Data Sheet (Page II-4).
- Subtract the two values and the difference should be less than 1 ohm.
- Record Results on Test Data Sheet (Page II-4).

MANUAL TEST

- Check to see that the unit is connected to live AC mains. The **POWER** light should be lit.
- Remove battery from the Base PowerCharger^{1x1}.
- Press the **TEST** button.
- The unit will light all LEDs for a few seconds. The **TESTING** and **BATT. READY** LEDs will light for a couple of seconds. Then all LEDs except the power light extinguish.
- Ensure that the **FAULT** indicator is off.
- If the **FAULT** light is lit, the unit is defective in some way. To identify the defect press and hold the **TEST** button. Illumination of specific indicator lights together represent a specific defect. (Refer to **FAULT CODES TABLE** on page III-3 to identify the fault and take corrective action).

  NOTE: The device under test should be at operating temperature before checking/adjusting voltages. (Device powered up for a minimum of 20 minutes).
- Set the DVM to VOLTS DC.
- Test the battery compartment by placing the Black lead of the DVM on the left battery contact pin of the battery compartment and place the RED lead of the DVM on the shrouded (middle) pin.
- The voltage measurement on the DVM should be 11.75 ± 0.25 VDC.
- Record Results on Test Data Sheet (Page II-4).

AUTO TEST OPTION

- Install battery into the battery well and observe that the **CHARGER ON** and **TESTING** LEDs are illuminated.

NOTE: The **CHARGER ON** and **TESTING** LEDs may go off within minutes, depending on the charge state of the battery pack installed. (i.e., Fully Charged)

QUICK CHARGE OPTION

- Install battery into the battery well and observe that the **CHARGER ON** LED remains illuminated until the battery is “READY”.
- The **TESTING** LED will **not** turn on by installing a battery into the charger.

BASE POWERCHARGER^{1X1}

DEVICE CHECKOUT PROCEDURE

DATA SHEET

S/N_____ OPERATOR_____ DATE_____

COPY THIS FORM BEFORE USING

SECTION 1. LEAKAGE TEST

Perform this Action:	Limits:	Circle the Result:
1.1 Chassis Leakage		
Normal Pol. w/ Ground	< 100 µA	**YES or NO**
Normal Pol. No/ Ground	< 500 µA	**YES or NO**
Reverse Pol. No/ Ground	< 500 µA	**YES or NO**
Reverse Pol. w/ Ground	< 100 µA	**YES or NO**
1.2 Ground Wire Leakage		
Normal Pol. No/ Ground	< 500 µA	**YES or NO**
Reverse Pol. No/ Ground	< 500 µA	**YES or NO**

SECTION 2. FUNCTIONAL TEST

Perform this Action:	Look for :	Circle the Result:
2.1 Continuity and Isolation		
Resistance measurement of two (2) leads shorted to one another.	Record value: _____ohms	
Resistance measurement with Red lead on metal and Black lead on powercord ground.	Record value: _____ohms	
Subtract the two values above.	Difference should be < 1 ohm	**YES or NO**

SECTION 3. MANUAL TEST

Perform this Action:	Look for :	Circle the Result:
3.1 Remove the battery from the Base PowerCharger[1x1]		**YES or NO**
Press the battery compartment **TEST** button (4).	All LEDs illuminate momentarily, the **Batt. Ready** and **Testing** light illuminate alone and then all LEDs go off except the Power LED.	**YES or NO**
	Ensure **FAULT** indicator is off.	**YES or NO**
Set DVM to VOLTS DC.		**YES or NO**
	Voltage is 11.75 ± 0.25 VDC	**YES or NO**

SECTION 4. AUTO TEST

For 1x1 base chargers that are configured as auto test units.		
Perform this Action:	**Look for :**	**Circle the Result:**
4.1 Install Battery into the battery well .	Charger on and testing LEDs illuminate.	**YES or NO**

SECTION III
TROUBLESHOOTING

This section answers many of the common problems or questions that arise during operation.

If trouble persists after consulting this guide, contact the appropriate technical personnel or ZOLL Technical Service Department.

TABLE OF CONTENTS

1. Troubleshooting Table III-2

2. Fault Codes Table III-3

3. Definition of Fault Codes III-4

TROUBLESHOOTING TABLE

Symptoms	Troubleshooting Method and Possible Causes
POWER light does not illuminate.	• Check that the unit is plugged into an appropriate power source. • Check for defective power cord. • Plug unit into another power source. • Check for blown fuse. Disconnect power cord and open fuse holder to check fuses.
CHARGER ON indicator light does not illuminate when battery is inserted into compartment.	• Check that the battery is properly seated in battery compartment. • Check that battery contacts are clean and not damaged. • Check that unit is plugged into an appropriate power source. • Test the battery compartment for functionality. • Place another battery in the compartment.
TESTING light does not illuminate when **TEST** button is pressed.	• Check that the battery is properly seated in compartment. • Check that unit is plugged into an appropriate power source. • Remove the battery and press the **TEST** button to perform a compartment self-test. If it does not self-test the button is defective.
Battery fails test cycle. (**FAULT** light illuminates with **TESTING** light).	• Verify that the battery compartment is fully operational with no defects. • Press and hold the **TEST** button to determine the fault code. (See **Fault Codes Table** on Page III-3). • If **FAULT** LED is on, most likely there is a failure in the circuitry.

When the unit does not follow the Power-Up sequence explained elsewhere in this manual or if a fault light comes on at any time follow the steps listed below to identify the fault.

Note: The unit can be run through it 's self-test at any time, as long as there is no battery installed, by pressing the **TEST** button. When the self-test is invoked, the unit responds by lighting all the LEDs for a few seconds. This is followed by a beep and then the **TESTING** and **BATT. READY** LEDs light for a couple of seconds. Then all LEDs extinguish except the power LED.

Faults that may endanger the reliable charging of a battery or the ability to charge/test successfully are latching faults that can only be cleared by power cycling after the fault is fixed. All other faults are self-clearing as soon as the fault condition is removed.

Fault Codes Table

When the FAULT indicator light illuminates, press and hold the **TEST** button. The illumination of the following indicator lights together represent a specific defect identified under the **Fault Code** column.

Charger On	Batt. Ready	Fault	Testing	Fault Code
ON	OFF	OFF	OFF	**Constant Current Voltage**
ON	**ON**	OFF	OFF	**Discharge**
ON	**ON**	**ON**	OFF	**Discharge Time**
ON	**ON**	**ON**	**ON**	**OverCharge**
ON	**ON**	OFF	**ON**	**Temperature**
ON	OFF	**ON**	**ON**	**Low Battery Voltage**
ON	OFF	**ON**	OFF	**High Constant Current**
ON	OFF	OFF	**ON**	**Shutdown**
OFF	**ON**	**ON**	**ON**	**High Battery Voltage**
OFF	OFF	**ON**	**ON**	**Battery Capacity**
OFF	OFF	OFF	**ON**	**Charger**
OFF	**ON**	OFF	OFF	**Constant Voltage**
OFF	**ON**	OFF	**ON**	**Vcc Voltage**
OFF	**ON**	**ON**	OFF	**Low Power Supply Voltage**
OFF	OFF	**ON**	OFF	**Low Constant Current**

NOTE: A battery that has failed a capacity test will display the **TESTING** & **FAULT** LEDs simultaneously. When the **TEST** button is pressed and held the LED pattern will not change. This is a normal operating condition and does not reflect a fault with the unit.

Definition of Fault Codes

Constant Current Voltage:	The Constant Current compliance Voltage is below the specified range.
Discharge:	Test discharge has been ineffective.
Discharge Time:	The unit is unable to perform the discharge test.
OverCharge:	The total delivered charge exceeds the specified range.
Temperature:	Internal charger temperature deviated from specified range.
Low Battery Voltage:	The Battery Voltage measured was below specified range.
VCC Voltage:	The internal five (5) volt supply deviated from specified range.
High Constant Current:	The amount of current during a charge was above specified range.
Shutdown:	Safety shutdown (#2) is not operating properly (shutdown).
High Battery Voltage:	The Battery Voltage was measured to be above the specified range.
Battery Capacity:	The battery's capacity was measured to be below the specified range.
Charger:	Safety shutdown (#1) is not operating properly (charge enable).
Constant Voltage:	The Constant Voltage deviated from the specified range.
Low Power Supply Voltage:	The charging voltage was measured to be below the specified range.
Low Constant Current:	The amount of current during a charge was below specified range.

SECTION IV
FUNCTIONAL DESCRIPTIONS

This section describes the basic operation of the circuits and supplements the troubleshooting guides in Section III of this manual.

TABLE OF CONTENTS

1. System IV-2

2. Charger Circuit Description IV-3

3. Battery Compartment Circuit Description IV-4

1. SYSTEM

Product Overview

The ZOLL Base PowerCharger 1x1 (with QuickCharge or AutoTest) is a battery charger and testing system designed for management of Battery Packs used in ZOLL Medical Corporation resuscitation devices.

The ZOLL Base PowerCharger 1x1 can be configured in either the AutoTest or QuickCharge mode. This configuration is performed by ZOLL Medical Corporation prior to device shipment. The Base PowerCharger1x1 is clearly labeled AutoTest or QuickCharge on the charger label directly beneath the product name.

AutoTest

The ZOLL Base PowerCharger 1x1 with AutoTest automatically tests battery capacity with each battery recharge (when the battery has been depleted for 10 minutes or more) and illuminates the BATT. READY indicator when the battery is fully charged. With AutoTest, the full charging cycle is complete in eight (8) hours or less for the PD4410/Smart Battery and fifteen (15) hours or less for the XL Battery. The AutoTest feature virtually eliminates the need to periodically test battery capacity since this test is performed each time a battery is recharged. See the M Series Operator's Manual for battery run time information.

QuickCharge

The ZOLL Base PowerCharger 1x1 with QuickCharge illuminates the BATT. READY indicator when the battery is fully charged. The full charging cycle is complete in four (4) hours or less for the PD 4410/Smart Battery and eight (8) hours or less for the XL Smart Battery . The QuickCharge version provides no information regarding battery capacity because it does not test capacity with each recharge. The ZOLL Base PowerCharger 1x1 with QuickCharge relies on the user to manually initiate the battery test cycle at recommended intervals (see Manual Battery Testing Procedure) in order to confirm adequate battery capacity.

Standard Terms and Abbreviations

CV	Constant Voltage. Term applies to the type of charging technique used to charge a battery where a Constant Voltage is applied to the battery.
CC	Constant Current. Term applies to the type of charging technique used to charge a battery where a Constant Current is applied to the battery.
Main PCB	Refers to the electronics assembly which controls the voltage and current being supplied to the battery pack.
Embedded Processor	A software programmable device used to sense and process a series of input signals to produce control/status output signals.
LED	Light Emitting Diode.

Micro-processor	A software programmable device used to sense and process a series of input signals to produce control/status output signals.
mS	Milliseconds.
PCB	Printed circuit board.
μS	Microseconds.

2. CHARGER CIRCUIT DESCRIPTION

The charger circuit includes a DC power bus, VCC power supply, and voltage references. The occurrence of a fault condition in one of these circuit components may cause the charger to suspend operation.

In the following sections there will be periodic reference to a device's reference designation and pin number. For example, U3.5 will refer to pin number 5 of device U3. This information is to be associated with the charger's system diagram and schematic set. In a similar fashion there will be reference to the microprocessor's port designation. For example, P3.1 will refer to the microprocessor's bit 1 of I/O port 3. Refer to the 8051 Data Handbook for a detailed description of the 87C752 I/O port capabilities and other features.

DC Power Bus Circuitry

The ZOLL Base PowerCharger 1x1 uses an unregulated 30V DC Power Bus as the power source for its switching power supply control circuit. This DC bus is created from a 24Vac input which originates from a chassis mounted transformer and enters the board via 2 pin connector J3. This AC input is rectified by bridge BR1 and filtered by capacitor C133. R42 will dissipate the energy stored in filter capacitor C133 when the AC power is turned off.

+12Vdc Supply

U3 with R7 and R8 provide a regulated 12 volts. C1 provides RF bypassing. C2 is a voltage filter capacitor. D1 is a reverse current protection diode. D4 and D5 along with R9 and C3 rectify and filter this AC input voltage providing an unregulated 30Vdc input voltage for the fixed +12VDC output switching regulator U3.

Logic Power Supply

A +5V +/- .25V power supply is produced from the +12VDC supply to power the analog and digital circuitry on the board.

Reference Voltages

A two terminal, 1.235V band gap reference (U9) is used to create all of the reference voltages that are routed to the charging compartment. U9 is biased by R27 and buffered by amplifier U5B. C25 is an RF filter capacitor.

Amplifier U5D, along with gain resistors R22 and R23, are used to create a third 3.3V reference voltage. C18 and C19 provide RF filtering. C13 provides power supply bypass and filtering. This reference voltage is bussed to the A/D input of the microprocessor and used to verify the accuracy of the VCC supply voltage (refer to VCC Test Circuitry Section for more details). This self-test feature insures that all A/D readings are accurate and not corrupted by a faulty VCC supply voltage.

Battery Detection Circuitry

The battery detection circuit, which comprises the differential amplifier, U5C, and associated components, signals the microprocessor if a battery is installed into the charging compartment. The input signal for the circuit is the battery sense lead which enters the board, along with the battery positive and negative terminals, via connector J1. A resistor divider (R13/R14) is used to detect op amp input to keep the working voltage range within the VCC supply voltage. Each op amp within U5 is configured as a comparator with a 1.2V threshold reference presented to the negative input pin.

Diode D6 protects each amplifier from static discharge and C9 is used as a filter capacitor. C10 is an RF filtering capacitor. The charging compartment's microprocessor observes its battery detection signal at port P1.7 (U104.22) with a positive voltage signifying the presence of a battery.

3. BATTERY COMPARTMENT CIRCUIT DESCRIPTION

The following section describes the battery compartment circuit.

Microprocessor

The battery compartment contains a microprocessor that controls charging, discharging, and capacity testing of the battery. The microprocessor also monitors battery voltage, battery current, system ambient temperature and the system power supply to determine if any fault condition has occurred. Four status LEDs and a test switch are also controlled by the microprocessor.

The microprocessor (U104) is a 87C752 running at 6.144 MHz with 16K of internal ROM and 64 bytes of internal RAM. It also includes a five bit I/O port (port #0; pins 6 - 8, 23 and 24) and two 8 bit I/O ports (port #1 and #3; pins 13 - 22 and 1- 5, 25 - 27). The lower five bits of port 1 are configured as analog inputs (pins 13 - 19).

The operating frequency is derived from the external crystal circuit (Y101, C103, C102, R114) connected to the processor (at U104.10 and U104.11). R124 and C123 provide the reference voltage for the internal A/D.

C112, C13, C23, C128, C101, C130 are bypass capacitors associated with various IC's located within the battery compartment circuitry.

For a summary of the microprocessor I/O pin assignments and Battery Test, Charging Voltage and Current Settings see the following tables below.

Port & Pin	In / Out	Analog /Digital	Signal Name	Description
P0.0	--	D	--	- Not Used -
P0.1	--	D	--	- Not Used -
P0.2	--	D	--	- Not Used -
P0.3	O	D	WDO	Watchdog output.
P0.4	O	D	CAPOUT	PWM Capacity Level Indicator
P1.0	I	A	V_BATT	Battery Voltage
P1.1	I	A	V_TST	VCC Test.
P1.2	I	A	TEMP	Temperature
P1.3	I	A	I_SENSE	Current Sense
P1.4	I	A	FREQ	Clock Test
P1.5	--	D	--	- Not Used -
P1.6	I	D	TEST-	Enable support diagnostics (not available in all versions of code release).
P1.7	I	D	BAT_DET+	Battery Detection.
P3.0	O	D	CHRG_LED+	Charge LED
P3.1	O	D	RDY_LED+	Ready LED
P3.2	O	D	TST_LED+	Test LED
P3.3	O	D	FLT_LED+	Fault LED.
P3.4	O	D	SHUTDWN+	Charge Shutdown
P3.5	O	D	CHGENB1-	Charge control circuit enable.
P3.6	O	D	SSEL10-	Charge state select bit 0.
P3.7	O	D	SSEL11-	Charge state select bit 1.

Summary of the Battery Test and Charging Voltage and Current Settings

SSEL0-	SSEL1-	Control State	I Limit	V Set
1	1	Discharge	- -	Battery voltage
0	1	Discharge	- -	Battery voltage
1	0	CC Charge	0.500 Amps	16.5 Volts
0	0	CV Charge	1.0 Amps	~ 11.75 Volts (actual value changes with temperature)

Clock Test Circuitry

Clock testing is provided by the R123 and C122 R/C network. As part of its start-up verification sequence the microprocessor drives the port pin low and then releases it to charge up to VCC. After a delay of approximately 110 uS it reads the voltage to determine if it has reached the 2/3 charge point or approximately 3.3 volts. If it perceives the value to be outside acceptable limits it may be because the crystal oscillator circuit (Y101, C103, C102) is out of specification. In this event the microprocessor will revert to a fault condition to prevent improper operation.

VCC Test Circuitry

A VCC test is provided by the 3.3V voltage reference circuit which was presented in the "Battery Charger Circuit" section. The microprocessor reads the reference value through its A/D port (U104.14). If it perceives the value to be outside acceptable limits it may be because either the VCC power is out of specification or the reference device has failed. In either event the microprocessor will revert to a fault condition to prevent improper operation.

Watchdog Circuit

The Watchdog device (U101) provides two functions. First, it acts as a power on reset circuit to insure that the microprocessor is held RESET until the +5 volt VCC power supply is stable. The watchdog timer continues to monitor the power supply and drives RESET high if the VCC supply falls below tolerance (4.62 volts nominal) anytime during normal operation. Secondly, the device will reset the microprocessor if it does not receive a "refresh strobe" at its input pin (U101.7) at least once every 250 milliseconds. If a reset condition occurs, the microprocessor will be held reset for a minimum of 250 milliseconds.

Whenever the microprocessor is held reset by the watchdog, the switchmode power supply circuitry is also disabled via diode D103 and R117. As current is sourced through this device, the safety current limiting comparator (U103.13 and U103.14) turns on causing a "shut down" of the power supply output. Refer to Switchmode Power Supply Section for a detailed description of the switchmode power supply control circuitry.

Shut Down Control

The Watchdog device (U101) as described above has the ability to both disable the microprocessor and shut down power supply operation. The microprocessor also has the ability to shut down power supply operation in the event that a fault condition is detected. This control function is provided via inverter U106 and diode D102 via R117. As described in the previous section, current sourced through the diode causes the safety current limiting comparator (U103.13 and U103.14) to turn on producing a shut down of the power supply output.

Power supply shut down also occurs when the battery test load is enabled.

Charge Control Circuitry

The microprocessor establishes one of three different voltage and current control settings to support CV and CC battery charging and battery test. The following paragraphs describe the voltage and current control functions in detail.

A fail-safe charge enable circuit is provided which requires that the microprocessor is functioning properly before the current and voltage control limits are established. This is accomplished via the circuit built around the NOR gate U107C. During normal operation the microprocessor produces a pulse train (signal CHGENB1-) with a frequency of approximately 500 HZ and a pulse width of approximately 10 μS. This signal passes through the DC blocking capacitor C132 where it is buffered and inverted by U107. The output of U107 (U107.8) is rectified by the network comprised of D110, C131 and R140 which charges up to +5V at each pulse. After the voltage across C131 exceeds 2.4 volts both Schmitt triggered gates (U107B and U107D) are enabled. Since the R/C time constant of C131 and R140 is much slower than 500 Hz, the rectified voltage does not have time to drop below the logic high threshold limits of U107.4 and U107.12 before the next pulse occurs. If a failure causes the microprocessor to halt, leaving the CHGENB1- signal at either a stable logic high or logic low, R141 will pull both U107C.9 and U107C.10 inputs high. This action causes the mode select gates (U107B and U107D) to be disabled.

Diode D111 is provided to prevent the voltage transition which comes through C132 from exceeding the high and low input signal requirements of the CMOS logic (at U107.9 and U107.10).

One of two possible voltage and current limiting values are selected via control gate U107A and U107B. The microprocessor asserts SSEL10- low (at U104.26) to select a one amp charge rate (FET Q104 turned off via control gate U107A) and a nominal CV voltage setting of 11.75 volts (FET Q102 turned off via control gate U107A). If the SSEL10- signal is driven high, FETs Q104 and Q102 are turned on to establish a current control setting of 500 mA and a voltage limit of 16.5V by placing shunt resistor R129 across R104 via Q104 and R120 across R119 via Q102. the gate of Q102 is protected by R121 and the gate of Q104 is protected by R130. For a summary of the current limits for each of the two charge select states see table on page IV-5.

Display Drive Circuitry

The four status LEDs; **CHARGER ON**, **BATT. READY**, **TESTING**, and **FAULT** are controlled by PORT 3 control lines of the microprocessor (U104 pins 2 -5). Each control signal is buffered by both a logic inverter (U106A, U106B, U106C and U106D). Resistors R1, R6, R10, R11 limit the LED on current to 15mA. Resistor R2 turns on the 'POWER' LED when the +5V VCC logic supply powers up.

See the Operator's manual for further clarification of the LEDs and their use.

Test Switch Interface Circuitry

A simple interface circuit and a single input port line is used to monitor the test switch. An internal pull-up resistor in the microprocessor holds the input pin high (port P1.6) until the test switch is pressed causing this signal to short to ground.

R134 limits the current into the microprocessor from a possible short circuit and D106 is used as a guard against static discharge.

Battery Voltage Sense Circuitry

The microprocessor monitors the switchmode power supply output and the battery voltage over a range of 8.5 to 16.5 volts to determine the battery's charge status and if it or the internal control electronics or the power supply has failed. The microprocessor resolves the voltage reading to within 50 millivolts (33mV, 8 bit) in order to support the battery charging algorithm requirements.

Op amp U8B forms a basic amplifier circuit with a gain of approximately -0.574 and an offset of 8.01V (established by the resistor combination R111, R112 and R110). Resistors R133 and R132 form a voltage divider to drop the battery voltage by a factor of 6 to keep the signal range within the input requirements of the op amp device (U8B). The resulting output signal (at U105.1), ranging from 0 to 4.85 volts is read by the microprocessor at its analog input (U104.13).

Capacitors C111 and C108 provide noise filtering while and capacitors C109 and C110 provide RF interference and static discharge protection. C23 is a power supply bypass capacitor.

A/D (voltage)=5-((Battery voltage-8.01)*0.574)

Current Sense Circuitry

The microprocessor monitors the supply current over a range of approximately 0 to 2 amps to determine the battery's charge status or if a control circuit has failed. The microprocessor resolves a current reading to within 8.3 milliamps in order to support the battery charging control requirements.

OP amp U8A forms a basic amplifier circuit with a gain of approximately 24 to amplify the current sense signal through the 100 milliohm resistor (R127). The gain of the circuit is established by resistor values R125 and R126. The resulting output signal (I_SENSE at U8-1), ranging from 0 to 4.85 volts is read by the microprocessor at its analog input (U104.16).

Capacitor C120 provides noise filtering while and capacitors C114, C115, and C116 provide RF interference and static discharge protection. R 106 is a balancing resistor in the non-inverting input line to the amplifier.

A/D (Current)=Battery Current*2.37

Switchmode Power Supply Operation

The Base PowerCharger [1x1] includes a switchmode power supply which establishes the configuration for the charging compartment. When a battery is inserted and charging is initiated, the switchmode power supply provides a constant voltage to charge the battery. As the battery charges up and the input current into the battery falls below a predetermined level, the battery charging mode is changed by the microprocessor to a constant current charge until the battery is fully charged. Upon completion of the constant current charge sequence, a timed overcharge is applied to insure that the battery has been fully recharged.

U103 is a fixed frequency pulse width modulation control IC that contains the building blocks for the power supply. As shown in Figure 1, U103 is configured in a "buck" orientation with power FET Q103 being the switch shown in the diagram.

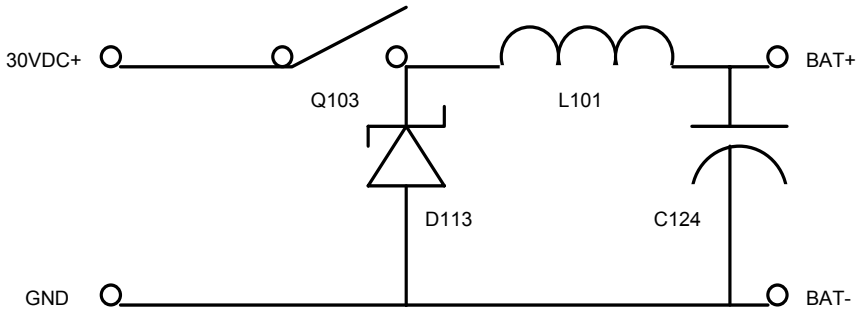


Figure 1 Buck Mode Switching Regulator

When the switch is closed, current builds through inductor L101 inducing a magnetic field. The amount of energy stored in the inductor depends upon how long the switch is closed. When the switch is opened, current starts to decrease through the inductor. The voltage at the cathode of D113 clamps to -0.4V as the current through the inductor decreases (V = L*di/dt). With catch diode D113 now forward biased, there is a path for the energy stored in the inductor to be transferred to the load. The cycle repeats itself with the "ON" and "OFF" time of the switch determined by a feedback control loop.

The PWM control device U103 operates at a 100KHz switching frequency which is determined by the C107 and R109 R/C network. An internal open collector transistor "switch" at U103.9 turns Q103 on through a series gate resistor R138 by pulling one end of R137 to ground. D109 clamps the gate-source voltage of Q103 to acceptable levels and the network consisting of Q105, D108 and R139 speeds up the turn-off time of Q103. There are three error feedback amplifiers that control the "ON" and "OFF" time of the internal switch; two of which are internal to the PWM control device and one control amplifier (U5A) that is external. All three amplifiers are OR'ed together at pin 3 of U103. The internal amplifiers are tied together and brought out to pin 3 of U103 and the external amplifier U5A is diode OR'ed through D101 such that the amplifier that demands minimum "ON" time, dominates control of the loop. Power to the regulator IC is filtered via R115 and C117.

When no battery is present in a charging compartment, the voltage feedback amplifier with inputs at U103.1 and U103.2 dominates control of the loop. The negative input of the amplifier is tied to the temperature compensated reference through R103 for isolation purposes. The positive input of the amplifier senses the power supply output voltage via voltage divider R128 and R119 through R108. The divider is filtered by C127 and C118. R/C network R102 and C106 compensate the amplifier ensuring stable operation. R120 is placed in parallel with R119 via Q102 to change the maximum charging voltage during CV or CC charging. R121 is the gate protection resistor in Q102.

During battery charging, the current feedback amplifier U5A dominates control of the loop. The output current of the power supply is measured through sense resistor R127. The sense voltage developed across this resistor is then compared to a fraction of the on board 1.2V reference determined by the voltage divider resistors R104 and R105. The result of this compare function is to limit the output current of the power supply to 1A during CV charging and by placing R129 across R104 to 500mA during CC charging. Capacitor C125 provides stabilization for this control loop. C105 and C113 provide RF filtering and C13 provides power supply bypassing. R107 is a balance resistor for U5A.

A second current feedback amplifier with inputs at U103.13 and U103.14 limits supply current to 2A in the event of a failure of amplifier U5A. Operation of this amplifier is similar to that of U5A with resistor divider R118 and R101 providing a reference voltage to compare against the voltage generated across current sense resistor R127 through R116. C129 stabilizes the amplifier ensuring proper control loop operation. R130 is a series gate protection resistor for Q104.

Battery Test Control Circuitry

The microprocessor initiates a battery test sequence when it has detected the presence of a battery in the charging compartment and the test switch has been pressed. A fail-safe charge enable circuit is provided which requires that the microprocessor is functioning properly before the test load can be applied to the battery. Refer to the **Charge Control Circuitry** section (Page IV-7) for a description of the Charge Enable Control circuitry.

Once the Charge Enable control is established, the microprocessor may either charge or discharge the battery to prepare a battery for use or determine its ability to perform under load. To apply the test load, the microprocessor asserts SSEL11- high (at U104.25) which places the load resistor (R3) across the battery via the output of U106.12 through R122 to the transistor Q101. As the load is applied across the battery, the power supply is caused to shut down via the current flow through diode D104.

Power Up Operation

At power on, the POWER indicator will turn on. The controller will perform a series of power-on diagnostics (including a test of the four LEDs) and then advance to the appropriate mode based on whether a fault is detected, a battery is present, and the status of the test switch. See **Diagnostics** Section for a detailed description of the power-on diagnostics.

If a fault is detected, the controller will revert to the FAULT Mode. Any power brown-out (< 90VAC) or interruption will cause a charging sequence to be restarted when proper power is re-established.

If a test is in progress during a power brown-out or interruption the controller will revert to normal operation when proper power is re-established. Press the **TEST** button to start the testing cycle again.

Turn on Delay

The system will delay no more that 10 seconds after power on to allow the battery/power electronics to stabilize and go through a self test. The **CHARGER ON** indicator will be turned on after the delay, if a battery is present.

Charge Mode

In Charge Mode, the controller performs a charging sequence on the battery. The **CHARGER ON** indicator will be turned on at this time. When the CV/CC charge sequence is completed the **CHARGER ON** indicator will be turned off and the **BATT. READY** indicator will be activated. For more information, see the Battery Charging Algorithm section.

Battery Test Mode

Battery Test Mode occurs when you press the **Test** button and a battery is detected by the controller. The **TESTING** indicator lights whenever the unit is in Battery Test Mode. The battery test sequence is as follows;

- First the battery will be fully charged.
- Battery charging will then be disabled.
- A test load will be presented to the battery.
- The capacity will then be calculated (see discussion below).
- Finally, the battery will be recharged.

If the capacity is determined to be adequate a **BATT. READY** indicator will be activated after the battery is recharged and the **TESTING** indicator will remain on. If the capacity is insufficient the **TESTING** and **FAULT** indicators will be activated at the end of the capacity test and the battery will be recharged, if possible. To abort this mode the user must either remove the battery or interrupt the AC power. Refer to the Battery Charging Algorithm section.

Unit Test Mode

Unit Test Mode occurs only if the test button is activated for two seconds with no battery installed. When a self test is performed all LEDs illuminate for a brief period of time and if successful the **TESTING** and **BATT. READY** indicator's are turned on for a few seconds or if there is a failure the **FAULT** LED is turned on and left on. This test will be also run automatically at power up and after a battery is removed.

Fault Mode

If a fault is identified by the controller, the **FAULT** LED will light (all other LEDs will be turned off). If the test button is activated for 2 seconds in this state then one of 15 patterns of the four LEDs will be activated to indicate the type of fault. This pattern will remain on only while the key is pressed. This mode will be reset every time a battery is installed or removed and at power up. See the Fault Codes Table in Section III for a description of the fault codes.

Idle Mode

If the battery is not in place the charger will remain in a standby mode (all LEDs are off except for the AC Power LED).

Battery Charging Algorithm

The algorithm used to charge the battery in both the charge and test modes is as follows;

- When a battery is installed the controller will begin charging operation in a CV charge mode. At this time a charge timer will be started.
- The CV mode will continue until the charge current drops to the constant current charge rate. The controller will then record the length of time "T" required to arrive at this CC charge point.
- The controller will then switch to a constant current charging mode and charge the battery at a CC charge rate until the battery's voltage peaks (i.e. remains constant or begins to drop) during a three minute period.
- The controller will then maintain a top off CC charge for a period of time equal to the value T (obtained above) divided by 20 (i.e. $Time_{TOP1} = T / 20$).
- Upon completion of the top off phase the controller will return to an appropriate mode to maintain a float charge on the battery. The controller will remain in this state until the AC power or the battery is removed.

Diagnostics

The following sections describe several types of diagnostics that will be performed by the system to insure product safety and simplify assembly and test requirements.

Power Up

As AC power is applied, the controller will perform a series of internal tests to determine if the electronics are functional. The following tests are performed ;

- **Timer Accuracy.** Verify that the internal clock/timing function has not shifted fundamental frequency.
- **Memory Validity.** Verify that all of the embedded processor's internal memory locations (RAM and ROM) are functional.
- **Power Supply Accuracy.** Verify that the logic power supply is within tolerance
- **LED Test.** Turn the four LEDs on for a short period.

If any of the first three functional tests fail, the controller will revert to the Fault mode (see Fault Mode section). It will be left to the user to verify that the LEDs are functional.

User Tests

This mode occurs only if the test button is activated for two seconds with no battery installed. A self test will be performed which will include turning on all LEDs for a brief period of time. If successful, the **TESTING** and **BATT. READY** indicator's will be turned on for a few seconds. If a failure is detected, the **FAULT** indicator will be turned on and left on. This test will also be run automatically after a battery is removed. The following tests will be performed:

- **Timer Accuracy**. Verify that the internal clock/timing function has not shifted fundamental frequency.
- **Memory Validity**. Verify that all of the imbedded processor's internal memory locations (RAM and ROM) are functional.
- **Power Supply Accuracy**. Verify that the logic power supply is within tolerance.
- **Charger voltage control test.** Verify CC and CV voltage levels

Run Time Tests

The controller will perform a series of internal tests to insure safe operation. Some of these tests will be performed continuously. Other tests will be performed at the appropriate moment of run time operation. A summary follows;

- **Power Supply accuracy**. Verify that the power supply is within tolerance.
- **OverCharge Timer test**. Performed during the CV/CC charge sequence. Limit the amount of time battery is subjected to charge to less than 6 AH.
- **Battery Voltage validity**. Performed during the CC charge sequence. Verify that the battery is within acceptable voltage limits.
- **Charge Current validity**. Performed during the CC charge sequence. Verify that the charge current is within acceptable limits.
- **Temperature validity**. Performed continuously. Verify that the temperature is within acceptable limits. If temperature is too high or too low the controller will disable constant current charging and will turn the FAULT indicator on.
- **Embedded Processor Operation**. Performed continuously. Verify that the processor is properly executing its program.

If any of these tests fail, the controller will either be disabled or will revert to the Fault mode.

For those faults in which the microprocessor is still functional, CV charge operation will be maintained. Except for a battery voltage failure the microprocessor will continuously attempt fault recovery. In the event of a battery voltage failure the microprocessor will stay in the fault mode until the battery is removed.

If the microprocessor is disabled the charge circuitry will revert to CV charge operation and the FAULT indicator will flash to indicate this condition to the user.

VCC SUPPLY

VOLTAGE REFERENCE GENERATORS

D1 1N4004
D2 GBL06
D3 1N4148
D4 1N4004
D5 1N4004
U3 LM317T
U4 LM317T
U5 LM324AN
U9 LM385BZ 1.235V
U10 OPEN (LM358AN)
R9 22 1/2W 5%
R8 2.61K
R7 301
R15 301
R16 909
R27 33.2K
C1 0.1UF
C2 10UF 25V
C3 220UF 50V
C4 0.1UF
C5 10UF 25V
C7 0.1UF
C13 0.1UF
C14 0.1UF
C18 47PF 200V
C19 47PF 200V
C22 0.1UF
C25 47PF 200V
C28 0.1UF
RT1 OPEN (10K) 25C
R20 10.0K
R24 10.0K
R12 10.0K
R23 23.7K
R22 14.3K
1_2REF 1.235 VOLTS
3_3REF
VCC
+12V

J3 3POS
AC1
AC2
SP1 OPEN
UNREG_DC+
R42 309K

JP3 3POS
HIGH=BASE POWERCHARGER 1 x 1 (QUICKCHARGE)
LOW=BASE POWERCHARGER 1 x 1 (AUTOTEST)
CONNECT 1–2 OF JP3
FOR POWERCHARGER 1 x 1

CHARGER SHEET 2
+12V
VCC
2:D7
2:A4 THERM
2:B6 PROD_SEL+
2:A4 3_3REF
2:C4,2:C8 1_2REF
2:B4 B1TST+
2:B4 B1FLT+
2:B4 B1RDY+
2:B4 B1CHRG+
2:A4 B1TSW–
2:A5 UNREGDC–
2:D1 B1BAT+
2:C1 B1BAT–

J2 TERMINAL
J4 TERMINAL
M1
M2
J5 TERMINAL
B1SENS
R14 100K
R13 100K
D6 1N5229B 4.3V
C9 47PF 200V
C10 47PF 200V
B1BDET+

SW1 SPST
R6 274
R10 274
R1 274
R11 274
R2 909
LED2 GREEN CHARGER ON
LED3 GREEN BATT READY
LED1 YELLOW FAULT
LED4 GREEN TESTING
LED5 GREEN POWER

C6 OPEN (47PF) 200V
R29 OPEN (4.75K)
R31 OPEN (5K)
R30 OPEN (4.75K)
R32 OPEN (10.0K)
VREF
2.8V NOMINAL (INCREASES .2V FOR EACH 5 DEGREE C RISE)

C8 OPEN (47PF) 200V

LS1 OPEN (AI–550KAS)
R4 OPEN
R5 OPEN
Q1 OPEN (MPSA06)
TO–92

NOTES

LAST USED REFDES ARE:C133,D115,J5,LED5,M5,Q105,R143,U107,Y101,SW1

NOT USED REFDES ARE:C4,C5,C7,C9–C21,C24–C27,C29–C100,C102–C110,J1,Q2–Q100

REV	DESCRIPTION	DATE	APP
B	CHANGED PER ECO 7732		
A	RELEASED PER ECO 6587	9/22/99	CK
3	CHANGED PER ECO 6458	6/29/99	CK
2	NOT RELEASED (ENG ONLY)	6/29/99	CK
1	RELEASE PER ECO 6413	6/7/99	CK

REVISIONS

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		DATE
DRW	C.MUSER	7/22/95
CHK	CK	6/7/99
DES	CJV	2JUN99
APP	CK	6/7/99

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BURLINGTON, MA. 01803

POWERCHARGER 1 X 1
MAIN, PCB
SCHEMATIC

DWG NO. 9301–0171–SC
REV B
SCALE 1/1
FILENAME 0171B
SHEET 1 OF 2
DATE & TIME 6–26–2002_14:39

OPTION 1. INDUCTOR BUCK CONVERTER WITH JP101 SHORTED AND INDUCTOR INSTALLED.
OPTION 2. FLYBACK CONVERTER WITH JP101 OPEN AND XFMR INSTALLED.

UNREG_DC+
C133 1800UF 50V
R108 1.02K
+12V
R115 10.2
R139 2.61K
Q105 MPSA06
D109 1N4745A 16V
R138 22.1
Q103 BUZ271
L101 47UH
L101 OPEN
D113 MUR120
D112 OPEN
INSTALL D113 OR D112
TV101 OPEN (TVS328)
BAT+
B1BAT+
1:C5
BAT LOAD
R26
R17 OPEN
R34 1.02K
R35 1.02K
R18 OPEN
R19 OPEN
R25 OPEN
R21 OPEN
R3 16 20W
R28 OPEN
OPEN
C126 0.1UF
R128 511K
R120 383K
R119 200K
C118 1000PF 50V
R133 200K
C124 1000UF 25V
R122 10.2K
Q101 BSS295
D105 OPEN (1N4734A) 5.6V
LOAD TEST CONTROL
B1BAT–
BAT–
1:C5
U106 74HC14
D104 1N4148
1:D1 3_3REF
R103 4.75K
R102 21.5K
C106 .047UF
U103 MC34060
PWM
VCC
VREF
DTC
GND
CT
RT
C117 10UF 25V
R137 100 1W
D108 1N4148
SWITCHING POWER SUPPLY
BAY1_EN 3:B3
R121 10.2K
D107 OPEN (1N4734A) 5.6V
Q102 TN0604N3
R129 1.33K
C129 0.01UF 50V
C125 0.01UF 50V
R118 68.1K
Q104 TN0604N3
R130 10.2K
CURRENT LIMITER
D101 SB140
U5 LM324AN
R116 10.0K
C107 3300PF
R109 3.48K
C105 47PF 200V
1:D6,2:D7 3:C4
1_2REF
R105 18.2K
R104 1.82K
C113 47PF 200V
IBAT CONVERSION
0.0A = 0V
0.1A = .237V
0.5A = 1.19V
1.0A = 2.37V
2.0A = 4.75V
R132 15.4K
C108 0.01UF 50V
R110 115K
U8 LM358AN
VOLTAGE MONITOR
1:D6,2:D7,3:C4
1_2REF
R111 14.3K
V_BAT1
V10UT
3:A4
C109 47PF 200V
+12V
C23 0.1UF
U8 LM358AN
R107 1.02K
R106 1.02K
C115 47PF 200V
C116 0.1UF 200V
R101 2.74K
R117 44.2K
R127 0.1 1W
R126 23.2K
C114 47PF 200V
VCC
D114 SB140
R112 86.6K
C111 0.1UF
C110 47PF 200V
VBAT CONVERSION
9 = 4.4V
10 = 3.8V
11 = 3.2V
12 = 2.7V
15 = 0.7V
R125 1.02K
CURRENT MONITOR
C120 0.01UF 50V
R142 1.02K
U7 74HC14
CHARGING_SHTDWN+
VCC
U106 74HC14
D102 1N4148
U107 74HC132
MODE CONTROL LOGIC
3:C4,C8 BAY1_EN
WATCHDOG
VCC
C101 0.1UF
U101 MAX1232CPA
TOL
PBRST
TD
ST
GND
VCC
RST
RST
D103 1N4148
FT102
FT101
PROD_SEL+
1:D6,2:D3
WDO–
U104 87C752 9212–0050
VCC
C112 0.1UF
RST
P0.0/AS
P0.1/CE
P0.2/VP
P0.3
P0.4/PWM
X1
X2
REF+
REF–
GND
FT103
R114 475 1/4W
Y101 6.144MHZ
R124 10.2
C103 33PF
C102 33PF
C123 0.1UF
LAMP DISPLAY SELECT LINES
U104_1
U104_5
U104_4
U104_3
U104_2
B1CHRG+ 1:D5
B1RDY+ 1:C5
B1TST+ 1:C5
B1FLT+ 1:C5
P3.0
P3.1
P3.2
P3.3
P3.4
P3.5
P3.6
P3.7
CHGENB1–
SSEL10–
SSEL11–
AD0/P1.0
AD1/P1.1
AD2/P1.2
AD3/P1.3
AD4/P1.4
INT0/P1.5
INT1/P1.6
T0/P1.7
B1ALRM– 1:D5
TEST_SWITCH
B1BDET+ 1:D5
D115 SB140
R143 1.02K
V_BAT1 3:C2
R136 1.02K
3_3REF 1:D6,2:C6
R135 1.02K
THERM 1:D6,2:C2
R134 475 1/4W
B1TSW– 1:C5
D106 1N4734A 5.6V
SSEL10–
CHGENB1–
C132 0.01UF 50V
U107 74HC132
D110 1N4148
SSEL11–
VCC
R141 68.1K
D111 1N4734A 5.6V
C131 0.01UF 50V
R140 487K
CHARGE SELECTION TABLE

SSEL10	SSEL11	CHARGE MODE
0	0	CV CHARGE
0	1	ENABLE TEST MODE
1	0	CC CHARGE
1	1	ENABLE TEST MODE

R123 100K
(U106) C128 0.1UF
(U107) C130 0.1UF
CLOCK_TEST
C122 0.01UF 50V
TO–92
TO–220AC FRONT VIEW
TO–220 FRONT VIEW

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ZOLL MEDICAL CORPORATION
32 SECOND AVENUE
BURLINGTON, MA. 01803

BASE POWERCHARGER
1 X 1
MAIN, PCB
SCHEMATIC

DWG NO.	REV
9301–0171–SC	B

DATE & TIME 6–26–2002_14:40
SCALE 1/1
FILENAME 0171B
SHEET 2 OF 2

SECTION V
DISASSEMBLY PROCEDURES

This section is designed to assist in the removal and replacement of Base PowerCharger^{1x1} components. Assembly and disassembly should be performed on a soft, protected work surface to guard against scratches.

WARNING

- Lethal voltages exist within the Base PowerCharger^{1x1}. Units should be serviced by qualified personnel ONLY!
- **Before removing any components, unplug the unit and remove the battery.**
- **Be sure to observe anti-static precautions whenever the unit is open.**

NOTE

- Cable paths and connector locations should be noted prior to disassembly. If cables are run in locations other than those indicated by the manufacturer, the unit may exhibit HI-POT failure, fuse blowing, or may not close properly.
- Torque specifications for screws are provided under the installation instructions.

1. REMOVING THE UPPER HOUSING COVER

TOOLS REQUIRED:

- No. 1 Phillips head screwdriver

1. Gently lift the LED label away from the Base PowerCharger [1x1] LED panel.

2. Remove the #1 Phillips screw from the LED panel.

3. Turn the unit over and remove the four (4) #1 screws the bottom of the unit.

4. Turn the unit over again and lift the Upper Housing Cover away from the unit.

INSTALLING THE UPPER HOUSING COVER

TOOLS REQUIRED:

- No. 1 Phillips head screwdriver

1. Reverse steps 1 through 4 above.

   NOTE:

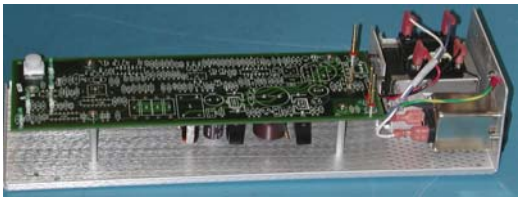
   - Four (4) screws to be torqued 7-9 inch pounds.

2. REMOVING THE PCB ASSEMBLY

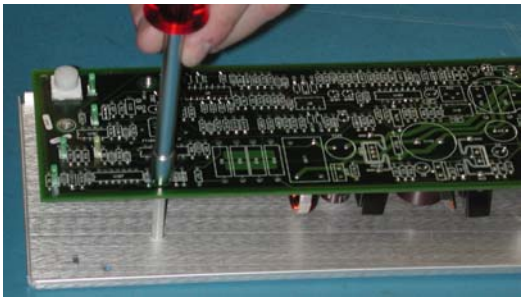
TOOLS REQUIRED:

- No. 2 Phillips head screwdriver
- Needle nose pliers
- ¼" nut driver

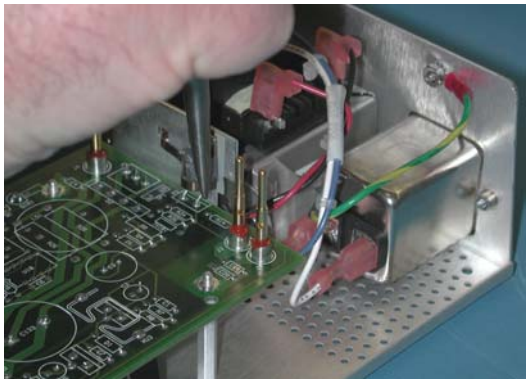
1. Remove the Upper Housing Cover as described on page V-2.



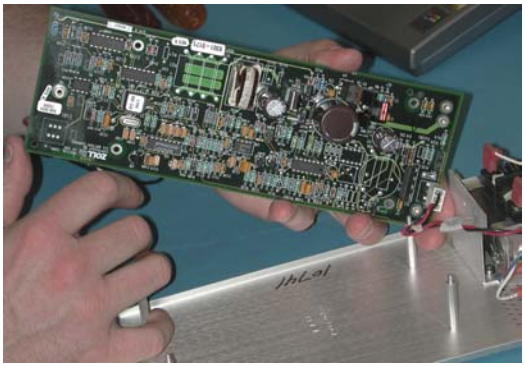
2. Remove the four (4) screws securing PCB to the base pan.



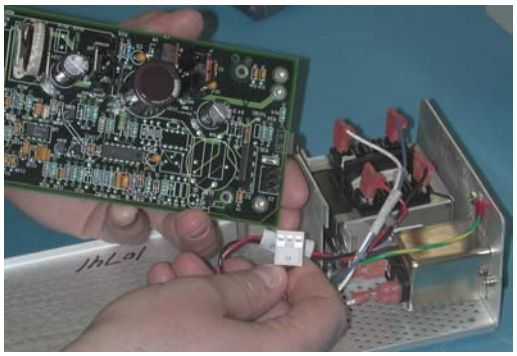
3. Remove the spring clamp securing the resistor (R3) by slightly twisting clamp with needle nose pliers.



4. Lift the PCB assembly away from the unit and turn over.



5. Disconnect the PCB Power Supply Harness (J3) from the PCB assembly.



INSTALLING THE PCB ASSEMBLY

TOOLS REQUIRED:

- No. 1 Phillips head screwdriver

1. Reverse steps 1 through 5 above.

   NOTE:

   - Screws (above) to be torqued 7-9 inch pounds.

3. REMOVING THE TRANSFORMER

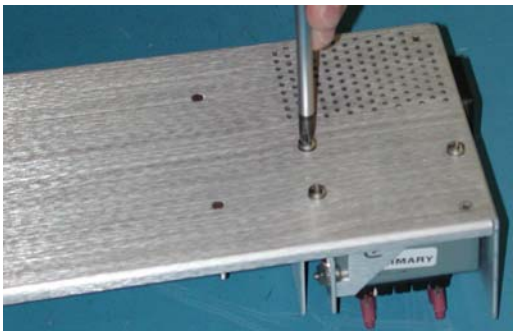
TOOLS REQUIRED:

- No. 2 Phillips head screwdriver
- Needle nose pliers

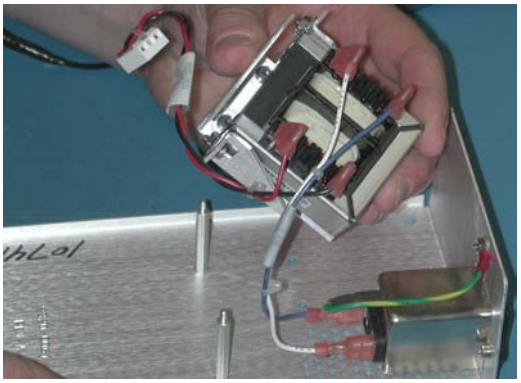
1. Remove the Upper Housing Cover. See “Removing the Upper Housing Cover” on page V-2.

2. Remove the PCB assembly. See “Removing the PCB Assembly” on page V-4.

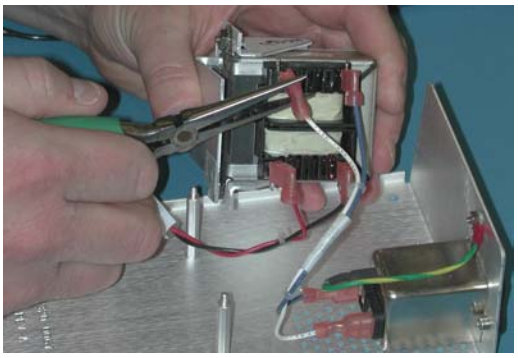
3. Turn unit over and remove the three (3) screws securing the Transformer to the base pan.



4. Lift the Transformer away from the unit.



5. Disconnect the PCB Supply Harness fastons and the Power Supply Harness fastons from the top of the Transformer (using needle nose pliers).



INSTALLING THE TRANSFORMER

TOOLS REQUIRED:

- No. 2 Phillips head screwdriver
- Needle nose pliers

1. Reverse steps 1 through 5 above.

   NOTE:

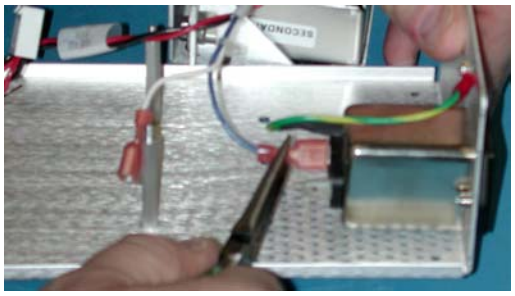
   - Screws (above) to be torqued 7-9 inch pounds.
   - The Power Supply Harness is routed under the ground wire (attached to the rear plate). If mis-routed, the Base PowerCharger^{1x1} may exhibit HI-POT failures or fuses blowing.

4. REMOVING THE POWER ENTRY MODULE

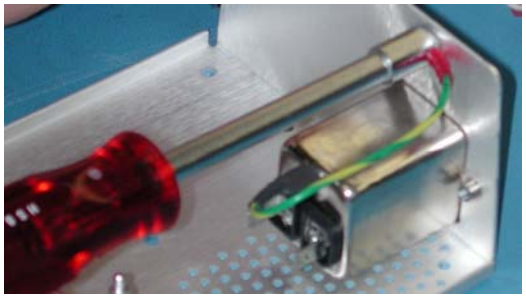
TOOLS REQUIRED:

- No. 1 Phillips head screwdriver
- ¼" nut driver
- Adjustable wrench

1. Remove the Upper Housing Cover. See "Removing the Upper Housing Cover" on page V-2.
2. Remove the PCB assembly. See "Removing the PCB Assembly" on page V-4.
3. Remove the Transformer. See "Removing the Transformer" on page V-6.
4. Disconnect the two (2) Transformer fastons from the Power Entry Module (using needle nose pliers).

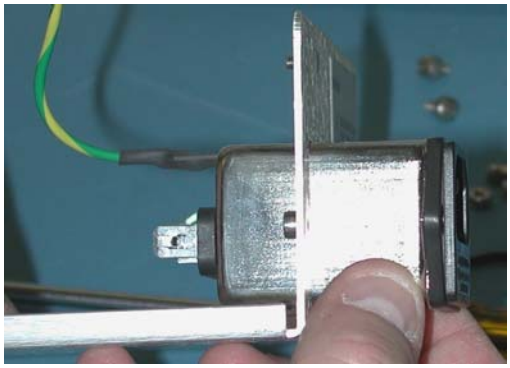


5. Remove the grounding screw from the rear plate.



6. Remove two (2) #1 screws securing the Power Entry Module to the rear plate.

7. Remove the Power Entry Module by sliding through the rear plate.



INSTALLING THE POWER ENTRY MODULE

TOOLS REQUIRED:

- No. 1 Phillips head screwdriver
- ¼" nut driver
- Adjustable wrench

1. Reverse steps 1 through 7 above.

   NOTE:

   - Screws (above) to be torqued 7-9 inch pounds. The two screws securing the Power Entry Module to the rear plate should be torqued 4-5 inch pounds.

SECTION VI
REPLACEMENT PARTS

This section contains a listing of the replacement parts available for the Base PowerCharger^{1x1} unit.

Replacement parts may be ordered through your sales representative, distributor, or directly from **ZOLL** Medical Corporation. When ordering parts, please provide the following information:

- the Base PowerCharger^{1x1} model and serial number
- Field Replaceable Unit part number
- Description of the replacement part

ZOLL reserves the right to substitute different parts to reflect modifications and improvements in **ZOLL** BasePowerCharger^{1x1} circuitry and design.

To order directly from ZOLL Medical Corporation, address your request to:

ZOLL Medical Corporation	Telephone	(800) 348-9011
32 Second Avenue		(781) 229-0020
Burlington, MA. 01803	FAX: Sales	(781) 272-5578
Attention: Technical Service Department	Service	(781) 229-0758

Current replacement part pricing is available from your sales representative or distributor. You may also contact ZOLL's Technical Service Department for price quotations.

FIELD REPLACEABLE UNIT

Description **Part Number**

ZOLL Base PowerCharger^{1x1} Chassis Assembly..... 1004-0303-01

This field replaceable unit comprises these parts:

1. Plastic Housing..... 9310-0137
2. Sem Screw 4-40 x 0.375"..... 0163-0992
3. Label, Logo, English 9305-0333-01
4. Label, Status Panel, English 9305-0336-01
5. Label, XL Battery Ready Logo 9305-0720-01
6. Test Switch Keycap..... 9310-0279
7. Screw, 4-40 x 0.500” 0163-0155
8. Rubber Foot, Screw Mount .562” Diameter x .0375” High..... 0310-0028
11. Foam Barrier..... 9330-0354
12. Fuse, 400 mA, 250 VDC, Time Delay, 5 x 20 mm 0180-0086

    (For 100-120 VAC Input)

    Fuse, 200 mAL, 250 VDC, Type T, 5 x 20 mm 0180-0085

    (For 200-240 VAC Input)